# Section 2
# Specifications

## PHYSICAL CHARACTERISTICS

| | |
|---|---|
| POWER REQUIREMENTS | 100/120/220/240 Vac, 50/60 Hz, 225 watts |
| DIMENSIONS | |
| HEIGHT | 7 in (178 mm) |
| WIDTH | 16.75 in (425 mm) |
| DEPTH (OVERALL) | 19.63 in (499 mm) |
| DEPTH (RACK MOUNT) | 17.95 in (456 mm) |
| WEIGHT | 54 pounds (24.5 kg) |
| SHIPPING WEIGHT | 60 pounds (27 kg) |
| TEMPERATURE LIMIT: | 0° to +50°C |

## FREQUENCY CHARACTERISTICS

| | |
|---|---|
| FREQUENCY RANGE 931 | 0.01 to 18.6 GHz |
| 932 | 0.01 to 12.4 GHz |
| ACCURACY (25°C after 30 minute warm-up) | |
| CW MODE | (0.01 to 2.999 GHz) ±20 MHz<br>(3.000 to 7.999 GHz) ±15 MHz<br>(8.000 to 18.6 GHz) ±20 MHz |
| FREQUENCY SWEEP MODE (Full sweep, sweep time ≥100 ms) | ±40 MHz |
| DELTA F MODE (<320 MHz width error as a percent of Delta F sweep width) | ±10% |
| MARKER ACCURACY | ±40 MHz |
| STABILITY | |
| WITH TEMPERATURE (0 to +50°C) | ±1.5 MHz/°C |
| WITH 10% LINE VOLTAGE CHANGE | <±100 kHz |
| WITH 10 DB POWER LEVEL CHANGE | <±500 kHz |
| WITH 3:1 LOAD VSWR | <±200 kHz |
| WITH TIME (10 minutes after 60-minute warm up at frequency) | <±200 kHz |

| | |
|---|---|
| RESIDUAL FM (30 Hz-15 kHz bandwidth) | <10 kHz peak |
| FREQUENCY REFERENCE VOLTAGE (nominal) | 1 Volt/GHz |
| FREQUENCY VERNIER RANGE | ±40 MHz |
| FREQUENCY VERNIER RESOLUTION | 10 kHz |

## OUTPUT CHARACTERISTICS

| | |
|---|---|
| MAXIMUM LEVELED POWER (25° ± 5°C) | |
| WITHOUT OPTIONS | +10 dBm (min.) |
| WITH 70 DB STEP ATTENUATOR | +7 dBm (min.) |
| WITH 20 MW LEVELED POWER OUTPUT | +13 dBm (min.) |
| WITH 20 MW LEVELED POWER OUTPUT AND 70 DB STEP ATTENUATOR OPTIONS | +10 dBm (min.) |
| CALIBRATED POWER RANGE | |
| WITHOUT OPTIONS | -2 to +10 dBm |
| WITH 70 DB STEP ATTENUATOR OPTION | -72 to +7 dBm |
| WITH 20 MW LEVELED POWER OUTPUT | +1 to +13 dBm |
| WITH 20 MW LEVELED POWER OUTPUT AND 70 DB STEP ATTENUATOR OPTIONS | -69 to +10 dBm |
| MAXIMUM ALLOWED POWER RANGE | |
| WITHOUT 70 DB STEP ATTENUATOR | -10.5 to +15 dBm |
| WITH 70 DB STEP ATTENUATOR | -80.5 to +15 dBm |
| POWER LEVEL ACCURACY | |
| WITHOUT OPTIONS (-2 to +10 dBm) | ±0.8 dB |
| WITH 70 DB STEP ATTENUATOR OPTION | |
| (-41.0 to +13 dBm) (specified) | ±0.8 dB |
| (-69.0 to -41.1 dBm) (typical) | ±2.0 dB |
| WITH 20 MW LEVELED POWER OUTPUT | |
| (+1 to +13 dBm) | ±0.8 dB |
| WITH 20 MW LEVELED POWER OUTPUT AND 70 DB STEP ATTENUATOR OPTIONS | |
| (-41.0 to +10 dBm) | ±0.8 dB |
| (-69.0 to -41.1 dBm) | ±2.0 dB |
| MAXIMUM SWEEP RATE (for power level variation) | ≥ 100 ms sweep or slower |

| | |
|---|---|
| POWER LEVEL VARIATION WITH FREQUENCY/WIDE BAND LEVELING | |
| (Normal power corrections over full band) | |
| INTERNAL LEVELING | |
| 10 to 19 MHz | ±0.4 dB |
| 0.019 to 7.999 GHz | ±0.2 dB |
| 8.0 to 18.6 GHz | ±0.4 dB |
| EXTERNAL LEVELING | |
| 10 to 19 MHz | ±0.5 dB |
| 0.019 to 7.999 GHz | ±0.3 dB |
| 8.0 to 18.6 GHz | ±0.5 dB |
| POWER LEVEL VARIATION WITH PRECISION CORRECTIONS | |
| (512 leveling points over a 1.024 GHz sweep range) | |
| INTERNAL LEVELING | |
| 10 to 19 MHz | ±0.2 dB |
| 0.019 to 7.999 GHz | ±0.1 dB |
| 8.0 to 18.6 GHz | ±0.2 dB |
| EXTERNAL LEVELING | |
| 10 to 19 MHz | ±0.3 dB |
| 0.019 to 7.999 GHz | ±0.2 dB |
| 0.8 to 18.6 GHz | ±0.3 dB |
| SPECTRAL PURITY | |
| HARMONICS | <-30 dBc (min.) |
| | <-40 dBc (typ.) |
| NON-HARMONICS (0.01 to 18.6 GHz) | <-55 dBc |
| SOURCE VSWR (50 ohms) | ≤1.7 : 1 |
| RESIDUAL AM (50 kHz bandwidth) | <-50 dBc |

## MODULATION CHARACTERISTICS

| | |
|---|---|
| INTERNAL AM | |
| NOMINAL FREQUENCY RANGE | 1 kHz |
| MINIMUM ON/OFF RATIO (from maximum RF power) | 30 dB |
| EXTERNAL AM | |
| SENSITIVITY | 1 dB/Volt |
| FREQUENCY RESPONSE (typical) | DC-50 kHz |
| INPUT IMPEDANCE (nominal) | 20 Kohms |
| AMPLITUDE CONTROL RANGE | 12 dB (min.) |
| MAXIMUM INPUT (without damage) | 20 Volts |

| | |
|---|---|
| EXTERNAL FM AND PHASELOCK | |
| NOMINAL SENSITIVITY | -6 MHz/Volt |
| MAXIMUM DEVIATION FOR MODULATION | |
| DC to 100 kHz | ±30 MHz |
| 100 to 250 kHz | ±10 MHz |
| INTERNAL PULSE (option) | |
| REDUCTION OF MAXIMUM LEVELED POWER (CW mode) | 1 dB |
| REDUCTION OF MAXIMUM LEVELED POWER ( Pulse mode) | 6 dB |
| MINIMUM ON/OFF RATIO | |
| (1 GHz to 2 GHz) | 70 dB |
| (2 Ghz to 18.6 GHz) | 80 dB |
| RISE/FALL TIME | ≤ 10 ns |
| MINIMUM PULSE WIDTH (leveled) | 50 ns |
| MINIMUM PULSE WIDTH (unleveled) | 50 ns |
| PULSE INPUT | TTL 50 Ohm BNC Female |
| EXTERNAL PULSE | TTL Low enables output |

Specifications subject to change without notice.

## FUNCTIONS

- CW
- Delta F (Full Frequency Range)
- Frequency Sweep
- Marker Sweep
- Power Sweep
- Frequency Steps
  - Specified Steps
  - Automatic Equally Spaced
  - Specified Increment
- Power Steps
  - Specified Steps
  - Automatic Equally Spaced
  - Specified Increment
- Manual Sweep
- External Sweep

# FEATURES

## MARKERS

- Up to nine markers available.
- Marker accuracy at full sweep, with sweep time ≥100 ms, is ±40 MHz.
- +5-volt, TTL-compatible marker pulse output available from the rear panel MARKER OUTPUT connector in Frequency Sweep and Marker Sweep modes.
- Marker frequencies may be substituted for any frequency parameter and for the frequency step table.
- Marker amplitude (nominal) is 3 dB below output power, 0.4% of sweep width.

## VERNIER

- May be used to change frequency, power, and sweep time values on lines addressed by the cursor on the CRT.
- May be used to change actual frequency output by up to ±39.99 MHz when the cursor is placed on the VERN F line on the CRT. This feature is available in CW, Power Steps, Power Sweep, and Manual Sweep modes only.

## RESOLUTION

- 1 MHz Frequency Display Resolution
- 0.1 dB Power Display Resolution

## SWEEP AND STEP TRIGGERING MODES

- Internal
- External
- Line
- Single
- Bus

## SWEEP FEATURES

SWEEP ACTIVE INDICATOR—Lights when sweep is occurring.

UNLEVELED INDICATOR—Lights when insufficient output power is available to maintain power leveling across the selected sweep range.

SWEEP OUTPUT—Front panel BNC connector that provides a 0-10 volt output proportional to sweep.

SWEEP AND STEP TIME—Adjustable from 0.03 seconds to 99.99 seconds in 0.01-second increments.

## MEMORY FEATURES

FUNCTION MEMORIES—Store the most recent configuration of each of the six principal functions in non-volatile memory.

SAVE/RECALL MEMORIES—Comprise nine locations of non-volatile memory for storing and recalling desired instrument configurations.

BATTERY—Provides back-up power for non-volatile memory. Battery life is greater than one year.

## REAR PANEL CONNECTORS

LOW-BAND AUXILIARY RF OUTPUT (.01 to 1 GHz)—BNC connector that provides output power $\geq$-20 dBm ±5 dBm.

AUXILIARY RF OUTPUT (1 to 18.6 GHz)—Type N connector that provides output power $\geq$-20 dBm ±5 dBm.

EXTERNAL FM INPUT—BNC connector with 10 Kohms input impedance and nominal -6 MHz/V sensitivity.

EXTERNAL AM INPUT—BNC connector with 10 Kohms input impedance and 1 dB/V sensitivity.

EXTERNAL FREQUENCY INPUT—BNC connector with 10 Kohms input impedance, accepts an externally applied 0-10 volt ramp for frequency sweep.

ANALOG FREQUENCY REFERENCE OUTPUT—BNC connector with 1 Kohm impedance, provides 1 V/GHz nominal output voltage directly proportional to frequency.

BLANKING OUTPUT—BNC connector that provides a +5 volt pulse for blanking during sweep retrace and band crossing and a -5 volt pulse for intensity markers.

MARKER OUTPUT—BNC connector that provides a 0 to 5 volt TTL-compatible pulse at each marker, coincident with the occurrence of RF markers.

EXTERNAL LEVELING INPUT—BNC connector with 10 Kohms input impedance that accepts input at 10 to 250 mV with input polarity either positive or negative.

STOP SWEEP—BNC connector that accepts TTL-compatible input. A TTL low signal (less than 0.8 V) stops sweep.

PULSE MODULATION (Standard)—BNC connector that accepts TTL-compatible input. A TTL high signal (greater than 2.4 volts) turns RF off. Maximum input is ±10 volts; maximum frequency rate is 50 kHz.

PULSE MODULATION (Option)—BNC connector that accepts TTL-compatible input. A TTL high (+2.5 to 5 volts) turns RF on. Maximum frequency rate is 30 kHz. Minimum pulse width is 50 ns. Rise/fall time is ⩽10 ns. Minimum isolation (1 to 18 GHz) is 70 dB.

SYNCHRONIZED VOLT OUTPUT—BNC connector provides +5 V pulse during sweep retrace and band crossing.

CRT INTENSITY—Potentiometer adjusts brightness of CRT.

## ACCESSORIES

The following accessories may be purchased at any time from EIP Microwave in San Jose, California at the address on the title page of the manual.

Cable Kit (For attaching 93X to a microwave counter)

Service Kit (Extender boards, tuning wands, torque wrench, power supply jumper)

Carrying Case

Rack Mount Kit with Handles

Rack Mount Kit without Handles

Rack Mount Kit for Customer-Supplied Slides

Rack Mount Kit with Handles for Customer-Supplied Slides

Rack Mount Kit with Slides

Rack Mount Kit with Handles and Slides

Line Cord (furnished)

Manual (furnished)

## OPTIONS

An option is a built-in functional and operational variation on the basic instrument. While options may be installed at a later date, it is more cost effective to purchase the instrument with the desired options. The options currently available for the 931/932 Microwave Source are:

| | |
|---|---|
| Option 9301 | Step Attenuator |
| Option 9320 | 20 mW Output Power |
| Option 9303 | Pulse Modulator |
| Option 9304 | 400 Hz Operation |

## OPTION 9301, STEP ATTENUATOR

The step attenuator option extends the RF power at the front panel connector to a range of -80.5 dBm and +7.0 dBm in 0.1-dB steps.

The attenuator has a 70-dB range and, when coupled with the range of the variable pin attenuator, gives the 931/932 a dynamic range of 87.5 dB.

With the step attenuator installed, all of the modes of the instrument will work as described in Section 3 of this manual, with the exception of Power Steps and Power Sweep. To describe the difference in operation of these modes it is first necessary to describe the way the step attenuator and the variable pin attenuator are used in controlling power.

Any attenuation may be set between 0 to 70 dB, in 10-dB steps (i.e. 0, 10, 20, 30, 40, 50, 60, or 70 dB). The pin attenuator is used to vary the power within the range of each 10-dB step. The various power ranges vs. step attenuator settings will differ depending upon whether or not Option 9320, (20-mW power output) is installed in the 93X. These ranges are summarized below in Table 2-1, for standard 10-mW output, and Table 2-2, for 20-mW output.

**Table 2-1. RF Power Ranges (10-mW Output)**

| STEP ATTENUATOR SETTING | NON-SWEEPING RF POWER RANGE | SPECIFIED RF SWEEP RANGE | MAX. POSSIBLE RF SWEEP RANGE |
|---|---|---|---|
| 0 | -4 to +7 dBm | -5 to +7 dBm | -10.5 to +15 dBm |
| 10 | -14 to -4.1 dBm | -15 to -3 dBm | -20.5 to +5 dBm |
| 20 | -24 to -14.1 dBm | -25 to -13 dBm | -30.5 to -5 dBm |
| **30** | **-34 to -24.1 dBm** | **-35 to -23 dBm** | **-40.5 to -15 dBm** |
| 40 | -44 to -34.1 dBm | -45 to -33 dBm | -50.5 to -25 dBm |
| 50 | -54 to -44.1 dBm | -55 to -43 dBm | -60.5 to -35 dBm |
| 60 | -64 to -54.1 dBm | -65 to -53 dBm | -70.5 to -45 dBm |
| 70 | -74.5 to -64.1 dBm | -75 to -63 dBm | -80.5 to -55 dBm |

Table 2-2. RF Power Ranges (20-mW Output)

| STEP ATTENUATOR SETTING | NON-SWEEPING RF POWER RANGE | SPECIFIED RF SWEEP RANGE | MAX. POSSIBLE RF SWEEP RANGE |
|---|---|---|---|
| 0 | -1 to +10 dBm | -2 to +10 dBm | -10.5 to +15 dBm |
| 10 | -11 to -1.1 dBm | -12 to 0 dBm | -20.5 to +5 dBm |
| 20 | -21 to -11.1 dBm | -22 to -10 dBm | -30.5 to -5 dBm |
| 30 | -31 to -21.1 dBm | -32 to -20 dBm | -40.5 to -15 dBm |
| 40 | -41 to -31.1 dBm | -42 to -30 dBm | -50.5 to -25 dBm |
| 50 | -51 to -41.1 dBm | -52 to -40 dBm | -60.5 to -35 dBm |
| 60 | -61 to -51.1 dBm | -62 to -50 dBm | -70.5 to -45 dBm |
| 70 | -71 to -61.1 dBm | -72 to -60 dBm | -80.5 to -55 dBm |

In the Power Steps mode, in a standard instrument equipped with the step attenuator option, the limits P1 and P2 may be set from -80.5 dBm to +7 dBm, with the constraint that P2 > P1. The corresponding range for an instrument with 20-mW output is -80.5 to +10 dBm. The only difference in operation with the step attenuator installed is that when the step attenuator setting is changed, there will be a time delay of about 200 ms while the attenuator switches.

In the Power Sweep mode, the step attenuator is not allowed to change settings. The entered values of P1 and P2 may still be between -80.5 and +7 dBm (or +10 dBm for 20-mW output), but the mean of P1 and P2 will be used to determine the step attenuator setting.

For example, suppose P1 = -70 dBm and P2 = +7 dBm. Their mean is -31.5 dBm. The step attenuator therefore is set to provide 30 dB attenuation, as can be seen from the first two columns of Table 2-1. The third column of the table shows that the guaranteed power sweep range will be from at least -35 dBm to -23 dBm, while the fourth column shows that the control circuitry of the source will attempt to provide a power sweep of from -40.5 dBm to -15 dBm.

## STEP ATTENUATOR POWER LEVELING (TEST 14)

The step attenuator may be calibrated to provide power flatness versus frequency at any specified power. The power calibration procedure is given in Section 5, Calibration and Adjustments.

## OPTION 9303, PULSE MODULATOR

Option 9303 provides fast, high-isolation,1- to 18.6-GHz pulse modulation. The pulse modulator uses two high-pass filters to remove the video from the pulsed RF and from the instrument's internal automatic leveling control. The modulators and the filters are switched in and out by means of a low-loss transfer switch, which is activated through the Configuration menu. See Figure 2-1. The pulse modulator driver provides the power to the pulse modulator and to the transfer switch. See Figure 2-2.

The pulsed signal reaches the modulator through the optional pulse modulation input connector on the rear of the microwave tray. A +5-volt, TTL high signal will turn the modulator on. The control impedance of the connector is 50 ohms to eliminate reflection on a long driving line. See Table 2-3 for pulse modulator specifications.

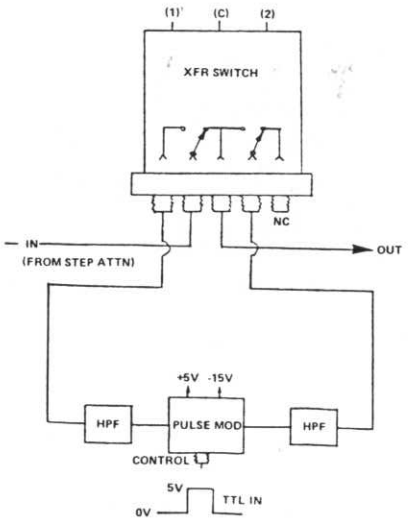


Figure 2-1. Pulse Modulator Schematic

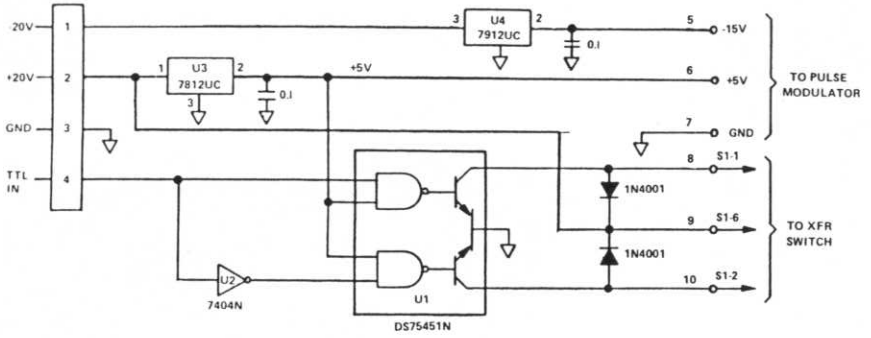


Figure 2-2. Pulse Modulator Driver

Table 2-3. Pulse Modulator Specifications

| | |
|---|---|
| Frequency Range | 1-18.6 GHz |
| Loss Modulator Out | 1.0 dB max. |
| Loss Modulator In | 6.0 dB max. |
| On/Off Ratio | |
| 70 dB | 1 to 2 GHz |
| 85 dB | 2 to 12.4 GHz |
| 80 dB | 12.4 to 18.6 GHz |
| Rise/Fall Time | 10 ns |
| Minimum RF Pulse Width | 50 ns |
| Duty Cycle | unlimited |
| Maximum Delay Time | 30 ns |
| Control Impedance | 50 ohms |